681129 Structural Development Interpretation of Idd El Shargi Field (Qatar) Based from Wide-Azimuth 4C Seismic Data - New Insights into Salt-Driven Dome Growth, Timing, and Implications for Reservoir Enhancement

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In this paper we present the results of an integrated study addressing the structural evolution of the Idd El Shargi oil field (Qatar). By combining well and 4C wide azimuth seismic data, we were able to build a model with a higher level of detail and genetically link the structure evolution in the context of the regional tectonic history. This project also allowed us to bring new insights into structural control of reservoir quality enhancement and compartmentalization, with implications for field development activities.

Idd-El Shargi oil field, located offshore Qatar, was discovered in 1960 and started producing in 1964. The hydrocarbons are mainly produced from stacked fractured carbonate reservoirs situated on a large NS-trending faulted anticline that has two salt-cored domes named Idd El Shargi North Dome (ISND) and Idd El Shargi South Dome (ISSD). Current production is sustained with an aggressive field development program through drilling of long-reach, multi-lateral horizontal producers and water injectors.

Our integrated seismic interpretation indicates that several regional tectonic and salt induced events have controlled the growth and faulting of Idd El Shargi. The main events and structural patterns can be summarized chronologically as follows:

Early rifting extension caused N-S oriented basement faulting at the Khuff level. This event can be correlated with the regional continental extension during opening of the Neo-Tethys ocean (Permian-Triassic). The basin deepening was marked by the deposition of Sudair formation (marine shales) and followed by Gulailah and Hamlah formations (with beds of silty marl, and anhydride streaks, graded with dolomites). At the same time regional extension induced salt diapirism at ISND that was rapidly followed by salt withdrawal, causing a combination of dome growth and graben formation.

After the major top Triassic unconformity (top Gulailah - Hamlah), the whole region went through a period of carbonate deposition over a broad platform that extended across the Middle East. No major salt tectonic events are evidenced at ISND during deposition of Uwainat and Arab formations (Jurassic); however, NW-SE oriented faults, related to the ongoing regional Zagros rifting, are visible on the Arab D-Yamama isochrone map. The regional dip at that time was towards NE.

The first signs of renewed salt activity can be seen on the Yamama-Kharaib isochrone (Early-Mid Cretaceous). Salt movement became more active after the deposition of the Shuaiba Formation (Lower - Mid Cretaceous), resulting in uplift and subaerial exposure which generated localized enhancement of reservoir quality (i.e. permeability) due to carbonate leaching and dissolution. This event created major implications for field development activities. The Nahr Umr deposition marks a major transgression and basin deepening; isochrones at this level suggest that no major salt activity/uptlift of the ISND occurred.

Faulting was very active through Late Cretaceous, and predominantly NE-SW oriented faults developed across the entire ISND structure, especially on its crestal area. This event can be correlated with the Tethyan closure (i.e. Late Cretaceous-Paleocene Oman ophiolite obduction, followed by the Eocene-Recent thrusting in the Zagros Mountains). As the younger NE-SW faults intersected the older NW-SE faults, fault bound reservoir compartments were created. The fault intersection and cross-cutting relationships can be clearly imaged using max/min reflection curvature data from seismic.
Detailed fault geometry mapping also suggests that overprinting of different faulting events, combined with changes in the stress field orientations, resulted in complex fault interaction patterns that can be best characterized as transpressional and/or transtensional tectonics.